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## DESCRIPTION OF STICTOCHIRONOMUS AFFINIS (JOHANNSEN) (DIPTERA: CHIRONOMIDAE), WITH NOTES ON ITS BEHAVIOR

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### ABSTRACT

The larva, pupa, and the male of *Stictochironomus affinis* (Johannsen) are described and illustrated for the first time from India. The female is redescribed to add some characters of taxonomic importance. Observations on larval behavior and ovipositional adult behavior under laboratory conditions were made.

### RESUMEN

Se describe e ilustra por primera vez de la India la larva, pupa y el macho de *Stictochironomus affinis* (Johannsen). Se redescribe la hembra para añadir caracteres de importancia taxonómica. Se hicieron observaciones sobre el comportamiento de las larvas y de adultos poniendo huevos bajo condiciones de laboratorio.

Since the erection of *Stictochironomus* as a genus by Kieffer (1919), the adults of several species belonging to this genus have been described from the Australasian, Ethiopian, Nearctic, and Palearctic realms. From the Orient, however, only *Chironomus* (*Stictochironomus*) *translucens* Johannsen was assigned to *Stictochironomus* (Sublette and Sublette 1973). The present paper describes the developmental stages and behavior of a second Oriental species, *Stictochironomus affinis* (Johannsen) occurring in India and which, prior to this study was known only from an adult female described by Johannsen (1932) from Bali, Indonesia, and treated as *nomen dubium* by Sublette and Sublette (1973).

#### MATERIALS AND METHODS

The material for this study consisted of larvae that were periodically collected from sandy bottoms of the Demodar River, south of Burdwan city, West Bengal, India. In the laboratory, these larvae were introduced into small rearing units (glass containers, 10 cm dia. and 30 cm high) enclosed in nylon cages (40 X 40 X 35 cm). The rearing units contained a 3-5 cm thick mud substrate and 20 cm of water. Small amounts of activated carbon and fine sand were added to each unit. Larval diet consisted of a mixture of ground rabbit chow and baker's yeast and was added to each rearing unit as needed. The rearing units were maintained at room temperatures of  $25.4 \pm 3^{\circ}\text{C}$  (winter) and  $32 \pm 2.5^{\circ}\text{C}$  (summer). Water in each rearing unit was changed every other day and exuviae were preserved for examination.

To observe larval behavior, 10 glass capillary tubes (each 2 cm long and 1 mm dia.) were placed in a rearing unit containing 15, 4th instar larvae of the species and a small quantity of the larval food as needed.

Adults of both sexes emerged in the cages, mated, and the female oviposited in the laboratory. The ovipositional behavior was studied by releasing 50-100 adults of the species in a cage provided with some larval-free rearing units which contained a few free-floating paper strips.

Morphological descriptions and terminologies follow Saether (1980). All measurements of structures given here are in mm unless otherwise indicated. The number before parentheses indicates the mean value where applicable.

The larvae, pupae, and imagines are currently being kept in the entomological collections of the University of Burdwan and will be deposited in the National Zoological Collections, Calcutta, India, British Museum of Natural History, London, England, and in the United States National Museum of Natural History, Washington, D.C., U.S.A.

#### DESCRIPTION OF LIFE STAGES

*Stictochironomus affinis* (Johannsen)

*Chironomus* (*Stictochironomus*) *affinis* Johannsen, 1932:525.

##### Fourth Instar Larva

Larva dark red, skin pale with brown sclerotised head capsule, claws of anterior and posterior parapods, anal setae and supra-anal setae. Total body length 6.45 (5.37-7.81, n=12).

Head: Brown. Posterior occipital margin with dark border and with vestiges of posterior tentorial pit, median suture distinct. Ventral length of head capsule (Fig. 1a) 0.21 (0.19-0.24, n=12). Eye spots paired, dorsal slightly larger than the ventral, in some cases appearing to be fused. Antenna (Fig. 1b) 6-segmented, basal antennal segment 0.050 (0.040-0.052, n=12) long and 0.019 (0.018-0.024, n=12) wide with a distinct ring organ 0.006 (0.005-0.006, n=12) in diameter, distance of ring organ 0.016 (0.014-0.018,

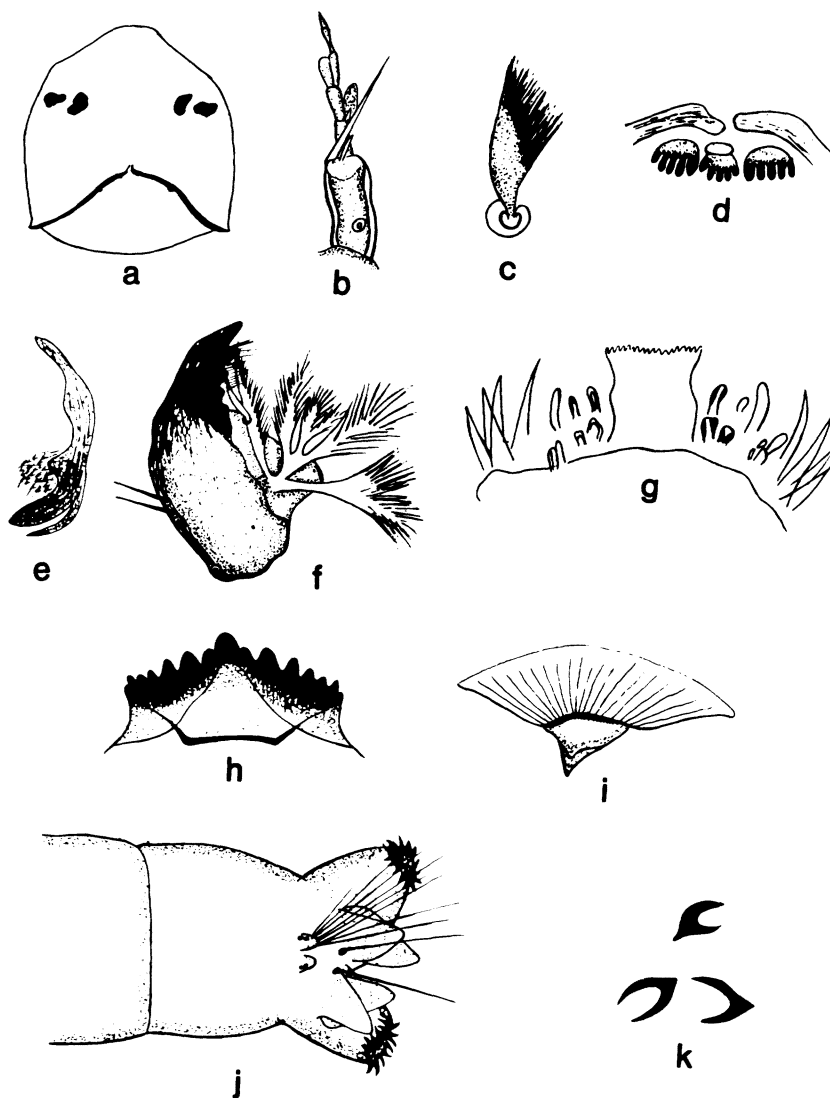


Fig. 1 a-k. Larva of *Stictochironomus affinis* (Johannsen): a. ventral head capsule; b. antenna; c. SI; d. pecten epipharyngis; e. premandible; f. mandible; g. prementohypopharyngeal complex; h. mentum; i. ventromental plate; j. last abdominal segments; k. claws.

n=12) from base, blade of basal antennal segment 0.038 (0.036-0.040, n=12) long, pointed, accessory blade 0.011 (0.010-0.012, n=12) long, antennal segment II with a lauterborn organ 0.013 (0.012-0.014, n=12) long and antennal segment III with a lauterborn organ at the opposite side 0.011 (0.010-0.012, n=12) long; length ratio of segments I-VI 11.5(11-12.5):3.2(3-3.5):3.5(3-3.5):4(3.5-4.5):2:1.5, AR 0.83 (0.80-0.84, n=10). Lab-

ral lamella more or less triangular with median lanceolate process and pectinate margin, SI (Fig. 1c) of labrum 0.019 (0.017-0.022,  $n=12$ ) plumose, the bases of two SI closely approximated, SII 0.040 (0.038-0.041,  $n=12$ ) also plumose, SIII with prominent base, SIVA simple and SIVB on a tubercle; chaetae of labrum 3-4 pairs fimbriated at apex, spinulae 2-3 pairs scalelike, chaetulae laterales of palatum 5 pairs, sickleshaped; pecten epipharyngis (Fig. 1d) consisting of three plates, median with 3-5 and each lateral with 5 subequal to equal teeth in a row, 1 pair setae mandibularis on tormal bar. Premandible (Fig. 1e) 0.071 long with 2 apical teeth. Mandible (Fig. 1f) 0.1 long with 1 apical and 3 inner teeth, sizes gradually decreasing laterad, seta subdentalis long and slender, weakly curved; seta interna with 3-4 main plumose branches, setae externa 2, ring organ of mandible 0.008 in diameter, mandibular brush distinct, mola with sharp indentation. Maxilla with well developed blade-like lacinial chaetae, anterior chaeta long, blunt; antaxial seta distinct with short rounded base; paraxial seta and pecten gallearis also distinct, sensillum basiconicum 1; maxillary palp 3-segmented, ring organ of segment I 0.006 in diameter; setae maxillaris 4 in number, SM<sub>1</sub> and SM<sub>2</sub> close together and SM<sub>3</sub> and SM<sub>4</sub> also very close. Prementohypopharyngeal complex (Fig. 1g) with a broad apically serrated median lamella, paramedian lamella indistinct, sensilla 3-4 each with a chitinised U-bar and a basal ring. Mentum (Fig. 1h) 0.06 (0.05-0.06,  $n=12$ ) wide with 1 median stout tooth and 7 pairs of lateral teeth, 1st pair broad and very close to the median appearing as a unit, 2nd pair largest, 3rd and 4th gradually decreasing in size, 5th and 6th more or less equal and shorter than the 3rd, 7th pair fused with preceding one and appearing as a projection. Ventromental plate (Fig. 1i) fan-shaped, 0.034 wide with distinct striae ending before margin. V/M 2.7 (2.3-2.8,  $n=8$ ).

Abdomen: Dark red. Anterior parapods bearing numerous weak claws (Fig. 1j), posterior parapods 0.16 long each with 12 claws of 3 different sizes (Fig. 1k), procercus 0.025 mm/0.042 mm, base with 8 anal setae, anal tubules well developed, conical 0.063 long. Pupa

Pupa brown, exuvia grey. Total body length 3.94 (3.86-4.03,  $n=6$ ) male, and 4.83 (4.28-4.95,  $n=6$ ) female.

Cephalothorax: Brown. Frontal plate (Fig. 2a) with 1 pair of frontal tubercles, frontal seta subapical. Antennal sheath in male 0.33 (Fig. 2b) and in female 0.64 (Fig. 2c) long. Thorax: rugulose; wing sheath 1.14 (1.12-1.16,  $n=6$ ) long; thoracic horn (Fig. 2d) with elevated base and 2 main bunches of finely branched filamentous structures, base of horn 0.025 wide. Precorneal setae 2 in number.

Abdomen: Pale brown and 9 segmented (Fig. 2e). Segment I with a pair of basolateral PSB, II with a pair of caudolateral PSB, IV with a pair of caudolateral PSB and a basolateral PSA. Tergite I with uniformly distributed spinules, II (Fig. 2f) also with well developed spinules and a caudal transverse row of 37-40 overlapping curved hooks, III-IV with spinules throughout the body and 2-3 rows of caudal spinous bands, V also with a median band of spinules, VI with broad basal band and narrow caudal band of spinules, VII with a narrow apical band of spinules, VIII with medially interrupted apical shagreen, IX also with a basal narrow band or shagreen like the previous one; segments I-VIII each with 1, 4, 7, 7, 6, 4, 6, 3 pairs of D setae respectively, segments II-VIII each with 2, 3, 3, 3, 3, 4 pairs of LS respectively of which LS on segments V-VIII filamentous; segment VIII with well developed caudolateral comb of 7-8 teeth (Fig. 2g), on each side. Anal lobe 0.25 (0.24-0.28,  $n=6$ ) long with no filamentous seta. Genital sac in male (Fig. 2h) 0.16 (0.14-0.17,  $n=6$ ) long, and in female (Fig. 2i) 0.19 (0.18-0.21,  $n=6$ ) long. G/F 0.60 (0.58-0.64,  $n=6$ ) in male and 0.75 (0.75-0.76,  $n=6$ ) in female.

#### Imago

Male: Body length 4.72 (4.69-4.79,  $n=10$ ), wing length 1.92 (1.87-1.98,  $n=10$ ) and wing width 0.53 (0.47-0.58,  $n=10$ ).

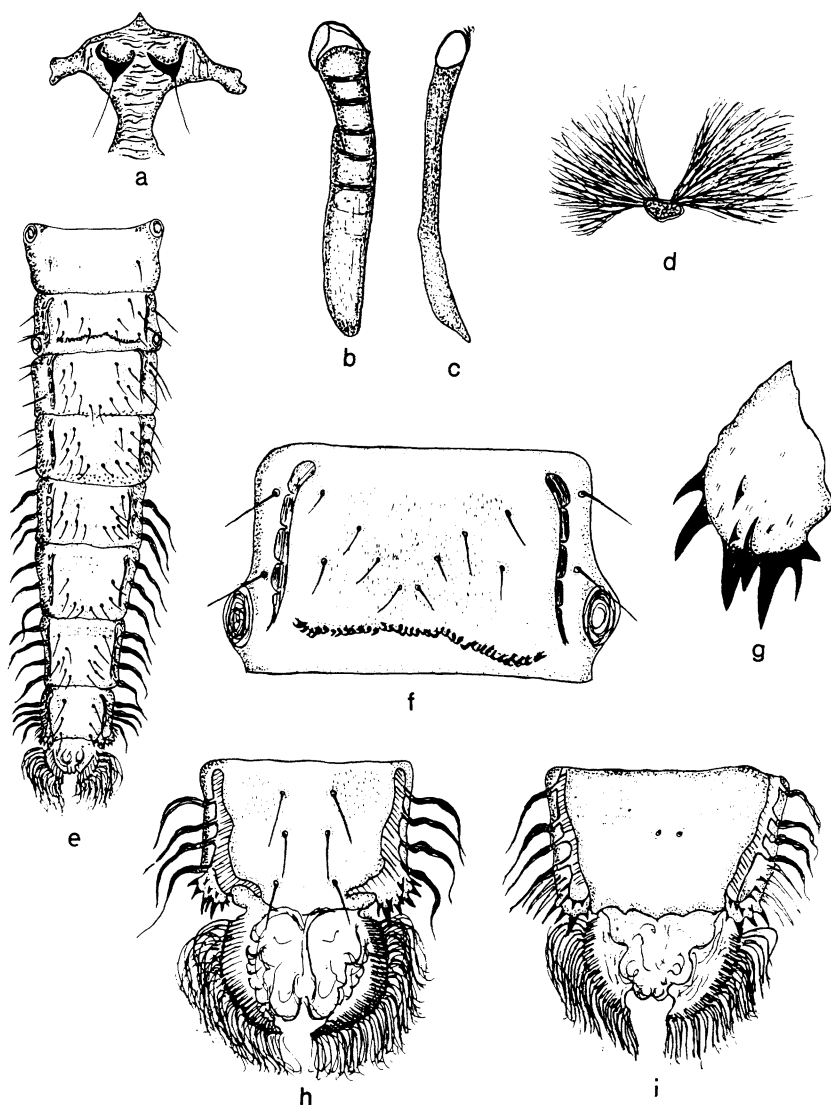


Fig. 2 a-i. Pupa of *Stictochironomus affinis* (Johannsen): a. frontal plate; b. antennal sheath ♂; c. antennal sheath ♀; d. thoracic horn; e. abdomen; f. tergite II; g. caudolateral comb; h. genital sac ♂; i. genital sac ♀.

Head: Yellow. Vertex brown with 15-18 (18) setae. Corona bare. Clypeus with 16-18 (16) setae, clypeal ratio 1.23. Maxillary palp brown, segment V bearing a few setae, length ratio of I-V 7:9:28:20:48, L/W 3.5. Eyes bare and comma shaped. Frontal tubercles present. Antenna brown, densely plumose, length ratio of flagellomeres I-XII 11:5:5:5:5:5:5:5:5:5:5:182, AR 2.98. Pedicel ratio 1.10, CA 0.63, CP 1.4.

Thorax: Yellowish brown. Anteprenotum reduced, mesonotum with 3 brown vittae;

acrostichals 22, dorsocentrals 26-28 (28), humeral 0, prealars 7-8 (8). Scutellum with dark posterior border bearing 24 setae, postscutellum brown and bare.

Wing: Hyaline with brown veins and iridescent grey spots (Fig. 3a). Brachiolium with 1 seta; R, 20-24, R<sub>1</sub>, 15-17 and R<sub>4+5</sub> with 29-32 setae; RM pale and FCu pale almost below RM. Anal lobe produced. Squama with 18-20 setae. Haltere yellow to brown and bare. CR 0.97, VR 1.00.

Legs: Yellow to pale brown. Femora brown except the apex; fore tibia bearing short pointed scale (Fig. 3b) and 3 long setae. Mid and hind tibiae with single spur. Tarso-meres brown except IV-V dark brown. Pulvilli small.

	Proportions and ratios of leg-segments									
	fe	ti	ta <sub>1</sub>	ta <sub>2</sub>	ta <sub>3</sub>	ta <sub>4</sub>	ta <sub>5</sub>	LR	SV	BV
Fore	38	34	47	32	24	20	11	1.39	1.30	1.36
Mid	42	39	27	11	9	7	6	0.69	3.68	3.27
Hind	43	46	37	20	16	10	6.5	0.80	2.73	2.40

Abdomen: Tergites brown with a median dark brown band along the mid dorsal line, margin of tergites dark. Hypopygium (Fig. 3c). Anal point 0.048 long, slender with subacute apex. Gonocoxite short, stout, with 16-18 long setae; gonostylus small, stout, abruptly attenuated bearing 1 long seta at its apex and 5-6 small setae at its inner apical margin. Superior volsella (Fig. 3d) well developed, curved, pointed, and medially bare; inferior volsella (Fig. 3e) uniform in diameter bearing 12 inwardly directed setae at its apex. HR 1.26, HV 3.04.

Female: Body length 3.87 (3.81-3.94, n=6), wing length 1.23 (1.14-1.33, n=6) and wing width 0.45 (0.44-0.47, n=6).

Similar to male with usual sex differences. Genitalia (Fig. 3f): Notum 0.1 long. Coxapodeme stout and wavy. Gonapophysis VIII with a broad dorsomesal lobe (Fig. 3g) and a small ventrolateral lobe (Fig. 3h) apodeme lobe (Fig. 3i) thin. Tergite IX with 2-3 setae. Postgenital plate normal. Labia without microtrichia. Seminal capsules equal, spherical 0.048 in diameter, ducts with a single bend or loop.

Material Examined: 15 larvae (reared in the laboratory), Demodar River, Burdwan, West Bengal, India, 2-18.ii.1982, Coll. P. K. Chaudhuri. 8 ♂♂ and 7 ♀♀ pupae (reared in the laboratory); 8 ♂♂ and 7 ♀♀ exuviae. 10 ♂♂ and 6 ♀♀ (emerged in the laboratory); 5 ♂♂ and 6 ♀♀, Durgapur, West Bengal, India, 11-13.vii.1983, Coll. S. K. Das. 1 ♀, type, Gilgit, Bali, Indonesia, 9.vi.1929, Coll. A. Thienemann (c/o British Museum of Natural History).

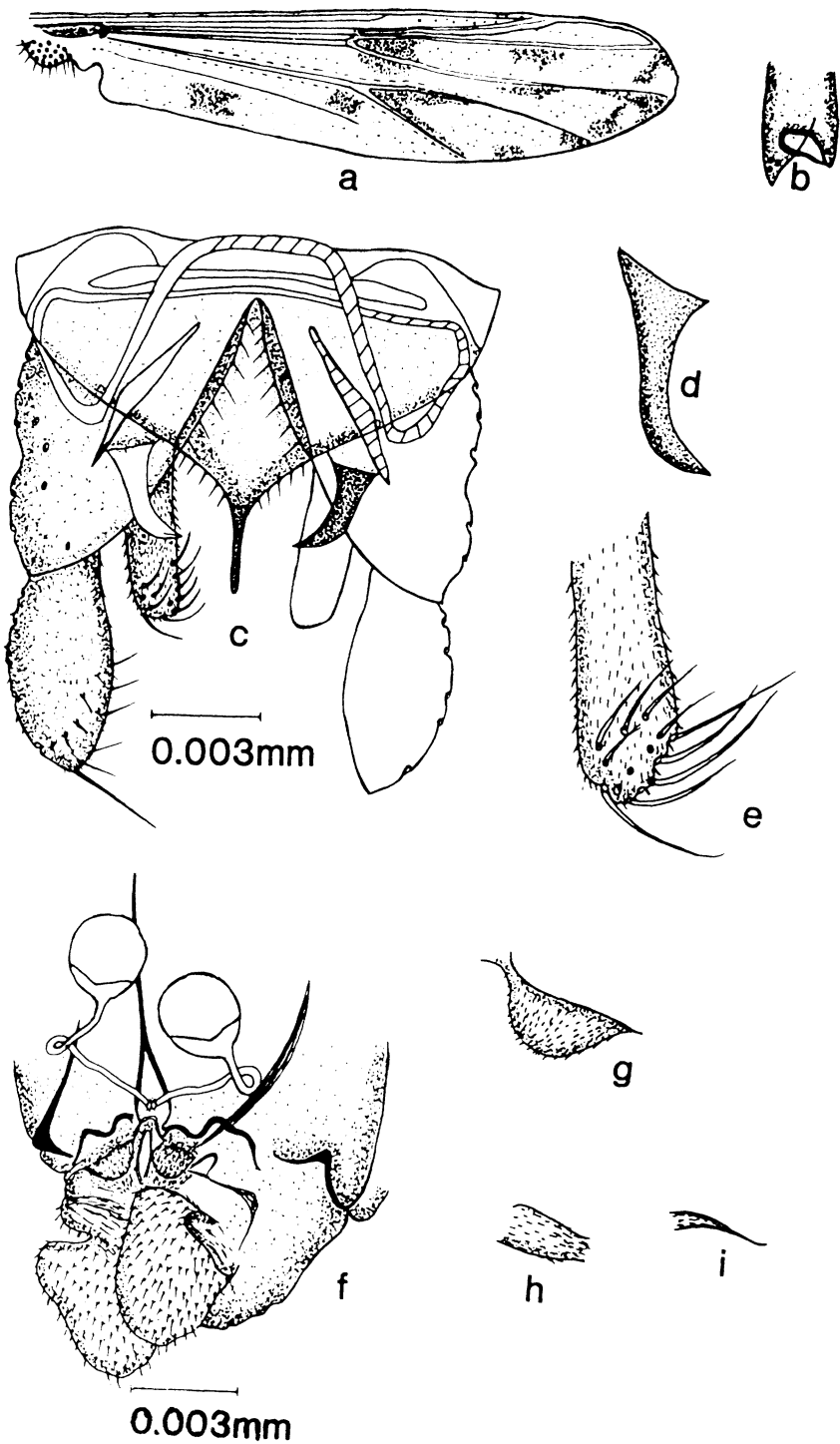
#### Remarks

This species was first described from a female as *Chironomus (Stictochironomus) affinis* by Johannsen (1932) from Bali, Indonesia. The identity of this species was confirmed by comparing the laboratory reared specimens with the published description of Johannsen and also by examining the type female specimen received from the British Museum of Natural History, London, England. Similarities in wing markings, legs, and other structural features were found. The male, described here for the first time, correlates well with the female except for the usual sex differences. The larva and pupa exhibit the characteristics of *Stictochironomus* Kieffer (Pinder and Reiss 1983, Wilson and McGill 1982). The larval features like the mentum, antenna, and pupal caudolateral comb of abdominal segment VIII appear to be close to those of *S. caffrarius* Kieffer as



Fig. 3 a-i. Imago of *Stictochironomus affinis* (Johannsen): a. wing ♂; b. fore tibial scale; c. hypopygium ♂; d. superior volsella; e. inferior volsella; f. genitalia ♀; g. dorsomesal lobe; h. ventrolateral lobe; i. apodeme lobe.







described by McLachlan (1969). However, the SI of labrum, pecten epipharyngis, antenna, mandible, prementohypopharyngeal complex and ventromental plate of larva; frontal tubercle, shagreen pattern, caudolateral comb of pupa separate the species from *S. cafferarius* and *S. translucens* and confirm its consideration as a member of the genus *Stictochironomus* from the Orient.

#### GENERAL BEHAVIOR OF LARVA

The larva is mesothermal. Larval collection was made from Demodar River and the larvae were reared to adult in the laboratory. Soon after larval release into the rearing units, the larvae made vigorous movement lasting approximately for 1 hour. Thereafter, the larvae started constructing tubes by using available sand and other substrate particles and binding these with their salivary secretion. The larva usually resided in the tube until pupation. During movement, the larva moved forward by straightening its body and extending anterior parapods forward, while in backward movement, the posterior parapods stroked backwards according to the degree with which the body was flexed. Frequently, some larvae were seen to suspend movement and bend like a horse shoe to remove any particles adhered to the anal surface by using the claws of posterior parapods and mouth armaments. The larvae released in the rearing unit containing capillary tubes approached the tubes at the completion of their vigorous movement and each larva entered a tube (head first) by forward body movement and remained there until pupation. The larva in the tube moved peristaltic-like along its longitudinal axis in the daylight at  $32 \pm 1^\circ\text{C}$ . Illumination of the rearing unit under a 60-w lamp during the day or at dusk stimulated the larval activity. Larvae in the capillary tubes also had a tendency to spin cases with their salivary secretion. These larvae were intolerant to any intruder to their tube; the intruder larva was swiftly chased out by the resident using its head. At an interval of 3-4 sec, the larva reached the opening of the tube to plug the opening with the larval-spun silken thread and also for aeration.

Ventilation: The larva fastened its anterior and posterior parapods to the rim or inner surface of capillary tube and moved wave-like. The movement appeared to initiate at the anterior end and proceed posteriorly. At times, the movement was suspended for 1-2 seconds. The wavy movement of the larva accelerated the speed of water flow through the tube. Food and sand particles carried by the incoming water sometimes retarded the flow. Some of these particles were trapped in the larval case by the sticky net made at one end of the tube. A blocked capillary tube at both ends, due to accumulation of the particles, resulted in suffocation and ultimate death of a larva. A continuous circulation of water flow (carrying dissolved oxygen) through the tube and bathing anal gills of the larva was necessary to keep the larva alive.

#### OVIPOSITIONAL BEHAVIOR

The selection of suitable oviposition sites by the female is of great importance to ensure that the eggs are adequately protected in the environment and appropriate food will be available to the hatched larvae. The egg-laying behavior observed in this study may be described in 3 phases: preovipositional, ovipositional, and postovipositional.

Preovipositional phase: The captive females appearing to be gravid were seen to rest on the roof and sides of the cage for 20-60 min, while a few (ca. 10%) remained on the floor. After resting, some females and a few males started flying haphazardly for 3-4 minutes. They were soon joined by others in similar behavior. Approximately 60% of the females then approached the rearing units while others including males returned for resting and ultimately died after 30-45 min. Most of the individuals approaching the

rearing units alighted on the paper strips while a few alighted on the water surface. The females resting on the sides of a rearing unit near the water surface moved around and directed their genitalia towards the water.

Ovipositional phase: The deposition of eggs took place during 2000-2300 hours. A slight diel periodicity of oviposition was noted. At the onset of egg laying on paper strips, the insect moved forward so that the egg mass would remain on the paper strip. During oviposition, the insect kept its hind legs apart on the water. After depositing eggs, the female flew away from the paper. The mass adhering to the legs of some females remained as such for 1-3 hours. In some cases, the egg masses detached from the legs and sank in the water. The individuals resting on the sides of a rearing unit near the water surface released eggs ca. 0.5 mm above the water surface. The females alighting directly on water deposited eggs after making short movements directed side ways. It was evident from the observations that the oviposition in the laboratory, in general, was preferred on floating objects, such as the paper strips used in this study over direct egg deposition on or near the water.

Postovipositional phase: The abdomen of females appeared to shrink a little after egg laying. Most of the females which had deposited eggs flew away within 2-3 min of egg laying for resting in the cage and stayed mostly inactive until their death 2-8 h post-oviposition. Some individuals had egg masses remained attached to their legs and lived as such for 2-12 h before dying.

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